

openings *ff*, the gas having then a free passage from the pipe *a* through the two sides of the frame *bb*, and into and through the plug *h*. It will be seen on reference to Fig. 6, that a small turn of the plug is sufficient to open or close the cock. *k* is a pipe screwed into the tube *e*, and leading to the burner *l*. *m* is a projection at the lower end of the plug, and *n* is a pin passed through the same. The plug is supported on the point of the pivot on which a magnet turns, so that very little power is required to turn the plug. *o* is a permanent magnet, which may be either cast in steel, with the two projecting pieces *pp*, or made out of a steel bar bent into the proper shape, and in this case the projections *pp* are produced by screwing in two pieces of metal. *q* is the pivot on which this magnet turns; it is passed through a vertical hole in the magnet, and fixed by a screw *r*. The lower end of the pivot rests in a steel step *s*, which is supported by a small wooden beam *t*, secured to the ends of the wooden bobbin *u*. *v* is the induction-coil; it is composed of a core of soft iron wire; two layers of primary wires wound with covered copper wire of about No. 20 BWG, and upon these about ten to fifteen layers of secondary wire of about No. 40 BWG. The primary wires *ww* form part of the circuit by which the lamps to be lighted or extinguished simultaneously are connected. One end of the secondary coil is connected to an insulated wire *x*, leading to the burner *l*, where it terminates in a platinum point, and the other end is connected to the frame *b*, or to any other metallic part of the apparatus, so as to be in metallic connection with the burner. The insulated wire *x* passes through an earthenware support *y* (seen in plan in Fig. 9), fixed to the pipe *k*. The soft iron core projects about three-eighths of an inch from each end of the wooden bobbin *u*. The bobbin is fastened to wooden supports *zz*, which are fixed to the frame *b* by screws *z<sup>1</sup>z<sup>1</sup>*.

Fig. 10 (for the use of which we are indebted to the Society of Arts) is a view of the complete apparatus as attached to a gas lamp.

#### AMERICAN SCIENCE

THE March number of the *American Journal of Science* opens with a valuable paper, in which Prof. Norton collates the various observations made on Coggia's comet. The theory of cometary phenomena he arrives at is (briefly) that the direct action of the sun on the side of the nucleus exposed to the solar rays is to form an envelope of gaseous carbonic oxide. This envelope of diamagnetic gas is traversed by the ideal lines of magnetic force proceeding from the nucleus, which are also lines of conduction through the gas. The electricity set free by the ascending currents of gas, by reason of the diminished gaseous pressure, is propagated along these lines, and the impulsive force of the electric currents detaches streams of the successive molecules of the gas in the direction of the lines of conduction. Both the nucleus and the sun exert repulsive forces on the escaping molecules; but their effective actions may be either repulsive or attractive, according as their attraction prevails over the attraction of gravitation, or the reverse. The author elucidates this theory at some length.

In a reply to Mr. Mallet's review (in the *Philosophical Magazine*) of General Abbott's paper on the velocity of transmission of earth-waves, in which the value and accuracy of the Hallett's Point observations were doubted, the General describes some new observations on the subject, which seem to establish these points: 1. A high magnifying power of telescope is essential in seismometric observations. 2. The more violent the initial shock the higher is the velocity of transmission. 3. This velocity diminishes as the general wave advances. 4. The movements of the earth's crust are complex, consisting of many short waves first increasing and then decreasing in amplitude, and, with a detonating explosive, the interval between the first wave and the maximum wave, at any station, is shorter than with a slow-burning explosive.

A new method for decomposition of chromic iron, proposed by Mr. Smith, consists in exposing it (in an exceedingly fine state) with bromine to a temperature of 180° C. from two to three days. Prof. Marsh furnishes an account of some new Dinosaurian reptiles.—Prof. Kimball describes some experiments on journal friction at low speeds.—There are also notes on some reactions of silver chloride and bromide, brightness of the satellites of Uranus, &c.

The new number of *Appalachia*, the journal of the Appalachian Mountain Club, contains a valuable address by the presi-

dent, Dr. S. H. Scudder, in which he reviews the principal scientific expeditions in the United States during the past year. Dr. Scudder himself is attached to the Hayden Survey, and made the discovery of the beds of fossil insects at Florissant, near Manitou, Colorado. During the past year 20,000 fossil insects have been exhumed from this quarry.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The fifth and final report of the Syndicate appointed in May, 1875, to consider the requirements of the University in different departments of study, has been issued. The Syndicate have considered the question of the residence to be required of professors. They are of opinion that it is desirable—(1) that the time for which the University may require the residence of professors shall be left to be determined by the University in the case of each professorship, without any general statutable restriction; (2) that no professor shall be considered to satisfy the condition of residence who is not for the time required making his home within a mile and a half of Great St. Mary's Church, unless special permission, available for not more than one year at a time, but renewable, be granted by the Vice-Chancellor and Sex Viri, and that such permission shall not be granted unless the Vice-Chancellor and Sex Viri are satisfied that the professor has made such arrangements as will secure his being reasonably accessible in Cambridge during term time. The Syndicate have also had under their consideration the importance of individual personal intercourse between students and teachers, and it has also been suggested that the inspection and revision of students' note-books by the teacher may in many cases be of considerable use. The precise manner in which such personal intercourse may be most effectually secured will probably vary very much in different subjects and for different teachers, but it seems important that the arrangements should be such that the professor himself may in all cases see a portion of the work of his class, so as to make himself accurately acquainted with their wants. The Syndicate have referred to the Board of Medical Studies the question whether it is desirable to found a complete medical school in Cambridge so as to make it possible for a student to complete his whole medical course here, or whether it is better for all concerned, while making the teaching at Cambridge as perfect as possible in the scientific subjects which are the basis of medicine, to leave students to carry on elsewhere the greater part of their clinical studies and most of what relates directly to the practice of medicine. The reply of the Board of Medical Studies states that they consider it inexpedient that students should complete their whole professional education at any single medical school, and that it is therefore desirable that students should pursue their studies away from Cambridge for a year or more before commencing practice, either before or after their final M.B. examination. They believe, however, that it would be in most cases advantageous to students to carry their medical studies in Cambridge further than is usually done at present, and in some cases as far as the final M.B. examination, and they are therefore of opinion that the University should provide systematic instruction in all the subjects necessary for a medical degree, as is done at other Universities. In order that this may be carried out satisfactorily the Board of Medical Studies think that the University should provide:—1. A Professor of Pathology. 2. A Professor of Surgery. 3. Systematic teaching in (1) midwifery and the diseases peculiar to women (2) medical jurisprudence; (3) sanitary science; (4) mental diseases. 4. Systematic clinical teaching.

R.G.S. PUBLIC SCHOOLS' PRIZE MEDALS.—The following is the award of the Public Schools' Prize Medals annually given by the Royal Geographical Society:—Physical Geography—Gold Medallist, William John Newton, of Liverpool College; Silver Medallist, Christopher Mounsey Wilson, of Clifton College; Honourably Mentioned—E. G. Harmer, University College School; M. H. Clifford and M. A. Soppitt, of Dulwich College; and J. S. G. Pemberton, of Eton College. Political Geography—Gold Medallist, William Wallis Ord, of Dulwich College; Silver Medallist, George Arnold Tomkinson, of Haileybury College; Honourably Mentioned—A. R. Ropes, of the City of London School; A. Kay, of Rossall School; and D. Bowie, of Dulwich College.

GREIFSWALD.—The University has received a grant of 381,000 marks for a new library building, and 200,000 marks for the construction of a physical laboratory.

### SCIENTIFIC SERIALS

*Bulletin of the Nuttall Ornithological Club. A Quarterly Journal of Ornithology.* Vol. III. January, No. 1.—This journal, on entering upon its third volume, has increased its quarterly numbers from a thin part of twenty-four pages to a part containing forty-eight pages and a coloured plate. It will continue, as before, under the editorial management of Mr. J. A. Allen, assisted by Prof. Baird and Dr. E. Coues, and it is intended that the volume for the current year should contain an exhaustive *résumé* of the current literature relating to North American Ornithology. The present number contains—Dr. E. Coues: On *Passerculus bairdi* (with plate), and *P. princeps*.—H. W. Henshaw on the species of *Passerella*.—W. A. Cooper: On the breeding of *Carpodacus purpureus*, var. *californicus*.—W. Brewster: On the first plumage of North American birds.—J. A. Allen: On Wallace's theory of birds' nests.—N. S. Goss: Breeding of the duck hawk in trees.—Notes of recent literature and general notes.

*Reale Istituto Lombardo di Scienze e Lettere, Rendiconti*, vol. xi. fasc. iii.—On the action of so-called catalytic force viewed according to the thermodynamic theory, by M. Tommasei.—Study on the dominant diseases of vines, by M. Garofalo and Cattaneo.—On the chronology of Tyrrhenian volcanoes, and on the hydrography of the Val di Chiana previously to the miocene epoch, by M. Verri.—On the permanent magnetism of steel at different temperatures, by M. Poloni.—On the plasmogonic production of leptothrix and leptomitrus, by M. Cattaneo.—On the refrigeration of pulverulent metallic solids (continued), by M. Cantoni.

### SOCIETIES AND ACADEMIES

#### LONDON

Royal Society, February 28.—“On the Reversal of the Lines of Metallic Vapours,” by G. D. Liveing, M.A., Professor of Chemistry, and J. Dewar, M.A., F.R.S., Jacksonian Professor, University of Cambridge. No. I.

In order to examine the reversal of the spectra of metallic vapours, the authors observe the absorptive effect produced on the continuous spectrum emitted by the sides and end of the tube in which the volatilisation takes place. For this purpose they use iron tubes about half an inch in internal diameter, and about twenty-seven inches long, closed at one end, thoroughly cleaned inside, and coated on the outside with borax, or with a mixture of plumbago and fireclay. These tubes are inserted in a nearly vertical position in a furnace fed with Welsh coal, which will heat about ten inches of the tube to about a welding heat, and they observe through the upper open end of the tube, either with or without, a cover of glass or mica. To exclude oxygen, and avoid as much as possible variations of temperature, they introduce hydrogen in a gentle stream through a narrow tube into the upper part only of the iron tube, so that the hydrogen floats on the surface of the metallic vapour without producing convection currents in it. By varying the length of the small tube conveying the hydrogen, they are able to determine the height in the tube to which the metallic vapour reaches, and to prevent further displacement of the vapour, and thus to maintain different lengths of the iron tube full of metallic vapour at a comparatively constant temperature for considerable periods of time.

By this means the following observations have been made up to the present time:—

The first metal experimented on was thallium, one of the most volatile of metals. After arranging the current of hydrogen so as to keep the tube free from air, but without any rapid movement of the gas, they saw the characteristic line reversed, and maintained it so for a considerable time.

The metal indium, closely allied in its behaviour and volatility to thallium, was next examined, and they observed the bright blue line reversed. This was most plainly visible when that portion of the vapour which was nearest to the sides of the tube was looked through.

They had great difficulty in preventing the oxidation of magnesium in the tube, and in using tubes wider than half an inch,

did not succeed in getting any reversal, but with half-inch tubes the *b* lines were clearly and sharply reversed, also some dark lines, not measured, seen in the blue. The sharpness of these lines depended on the regulation of the hydrogen current, by which the upper stratum of vapour was cooled.

A piece of metallic lithium was introduced, and gave no results. Sodium was next added in the same tube, and this did not bring out the reversal of the lithium lines. Similarly, chloride of lithium and metallic sodium, introduced together, gave no better results. To a tube containing potassium vapour, some lithium chloride was added, but no lithium line appeared. On adding metallic sodium to this atmosphere, and more lithium chloride, the bright-red lithium line appeared sharply reversed, and remained well defined for a long time. It is worthy of observation that the lithium line was only reversed in a mixture of the vapours of potassium and sodium, and it seems highly probable that a very slightly volatile vapour may be diffused in an atmosphere of a more volatile metal, so as to secure a sufficient depth of vapour to produce a sensible absorption. This would be analogous to well-known actions which take place in the attempt to separate organic bodies of very different boiling points by distillation, where a substance of high boiling-point is always carried over, in considerable quantity, with the vapour of a body boiling at a much lower temperature. It is a matter for future investigation how far chemical interactions taking place in a mixture of metallic vapours affect the volatility of a third body, and what relation, if any, this may have to such phenomena as the increased fusibility of mixtures of salts of potassium and sodium, and the well-known fluidity of the alloy of those metals.

As the authors have had occasion to use sodium and potassium in their tubes, they have had opportunities of observing the absorption spectra of these metals, and they find that there is a great deal yet to be observed in regard to these spectra. Up to the present time they have not observed any of the appearances noted by Lockyer, “On a New Class of Absorption Phenomena,” in the *Proceedings* of the Royal Society, vol. xxii., but they have repeatedly noted the channelled-space spectrum of sodium described by Roscoe and Schuster, in the same volume of the *Proceedings*. They observed in their tubes no channelled space absorption by potassium, but continuous absorption in the red and one narrow absorption band, with a wave-length of 5,730, not corresponding with any bright line of that metal.

With reference to the absorption spectrum of sodium vapour they remark that it is by no means so simple as has been generally represented. The fact that the vapour of sodium in a flame shows only the reversal of the D lines, while the vapour, volatilised in tubes, shows a channelled space absorption, corresponding to no known emission spectrum, appears to be part of a gradational variation of the absorption spectrum, which may be induced with perfect regularity. Experiments with sodium, carried out in the way described, exhibit the following succession of appearances, as the amount of vapour is gradually diminished, commencing from the appearance when the tube is full of the vapour of sodium, part of it condensing in the cooler portion of the tube, and some being carried out by the slow current of hydrogen. During this stage, although the lower part of the tube is at a white heat, we have always noticed, as long as the cool current of hydrogen displaced metallic vapour, that, on looking down the tube, it appeared perfectly dark. The first appearance of luminosity is of a purple tint, and, with the spectroscope, appears as a faint blue band, commencing with a wave-length of about 4,500, and fading away into the violet. Next appears a narrow band in the green, with a maximum of light, with a wave-length of about 5,420, diminishing in brightness so rapidly on either side as to appear like a bright line. This green band gradually widens, and is then seen to be divided by a dark band, with a wave-length of about 5,510. Red light next appears, and between the red and green light is an enormous extension of the D absorption lines, while a still broader dark space intervenes between the green and the blue light. The dark line in the green (wave-length about 5,510) now becomes more sharply defined. This line appears to have been observed by Roscoe and Schuster, and regarded by them as coinciding with the double sodium line next in strength to the D lines, but it is considerably more refrangible than that double line. In the next stage, the channelled space spectrum comes out in the dark space between the green and blue, and, finally, in the red. Gradually the light extends, the channels disappear, the D lines absorption narrows, but still the dark line in the green is plainly